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Sustainable energy investments in Hellenic urban areas: Examining modern financial mechanisms

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ABSTRACT

An initiative namely "SAVE or EXOIKONOMO" is implemented in Greece and includes development and implementation of municipal investment plans for sustainable energy development in urban areas. However, a part of the investments' funds is covered by the government and most of the municipalities have serious difficulties in successful participation in this initiative. As a result, further efforts and "new" financial mechanisms are necessary in order to support the implementation of sustainable energy investments in urban areas. The scope of the current paper is to investigate the potential of implementing "JESSICA" as a complementary financing mechanism in the context of the development of sustainable energy investments. In specific, the successful financing of the strategic plan by Rhodes Municipality in Greece for improving energy efficiency is analyzed in this paper. Based on the results, the utilization of JESSICA for financing sustainable energy investments in urban areas of municipal authorities seems to fit well into the overall requirements of JESSICA as a financing mechanism of integrated urban development.

Contents

1. Introduction

Greece, as a member State of the European Union (EU), aims to achieve the main EU objectives of "the three twenties", namely by 2020 a 20% share of RES in the final energy consumption, 20% energy saving and at least a 20% of CO_2 emission reduction by the same year. "EU Directive 2009/28/EC on energy uses form RES" and "Directive 2006/32/EC on Energy End-Use Efficiency and Energy Services" have been effectively transposed into national legislation [1].

In addition, an initiative namely "SAVE or EXOIKONOMO" has been implemented in Greece since 2009, under the umbrella of

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the "2007–2013 National Strategic Reference Framework" including development and implementation of municipal investments plans for sustainable energy development in urban areas. However, a part of the investments' (70%) are government covered [2]. Most of the municipalities have serious difficulties in the successful participation in this initiative. The above example is a typical case indicating the necessity of further efforts and "new" financial mechanism in order to support the implementation of sustainable energy investments in Greece.

The concept of "Financial Mechanisms" was introduced in Greece with the application of Law 3614/2007 within the Program for Managing, Controlling and Implementing Development Interventions for the 2007–2013 period. Rule no. 24 of this Law, "Means of Financing Technical", provides the foundation of treasuries and portfolio funds according to the definitions of European Regional Development Fund. On the 1st July 2010 a contract with the European Investment Bank was signed for the establishment of the portfolio fund "JESSICA". For this fund, €258,000,000 where committed from which 248 millions where committed for the Regional Operational Programs and 10 millions where committed to the "Environment—Sustainable Development" Operational Program. Additional amounts are expected to be added by the Civilization and Tourism sectors.

In this context, energy efficiency improvements seem to be one of the areas that the financial mechanism "JESSICA" should focus on, considering that energy efficiency constitutes a major component of sustainable urban development. JESSICA stands for Joint European Support for Sustainable Investment in City Areas. It is an initiative of the European Commission (DG REgio) launched in the beginning of 2006, supported by European Investment Bank and Council of Europe Development Bank. JESSICA's objective is to establish a common approach for financing urban development, thus strengthening the urban dimension in cohesion policy through the transformation of grants in repayable/recyclable assistance.

The main advantages of adopting the concept of JESSICA as financial engineering mechanism are [3]:

- It makes structural funds' support more efficient and effective by using financial tools that create strong incentives for project implementation.
- Mobilizes additional resources for urban development projects with a focus on sustainability.
- Utilizes the managerial and financial expertise of financing institutions.
- A strong reinvestment mechanism is established, through which financial resources are utilized in perpetuity.

Indeed, "JESSICA" is a modern financial mechanism, and its scope is the "recyclability" of Structural Funds' financial resources through a mechanism which will provide funding – equity, loans and guarantees – to eligible urban development projects, and will utilize the returns – for instance loan repayments – to reinvest in new urban development projects, thereby bolstering sustainability.

To the best of our knowledge, during the last 20 years there have been a number of publications, concerning financial mechanisms and schemes in various energy efficiency investments. In particular, other initiatives in Europe in which there was recycling of savings/investments are "Woking" in the UK and "Fifty–Fifty" in Germany. "Woking" is recognised as the UK's most energy efficient council with good reason. Its combined programs and innovation have delivered measurable results across the community [4]. The Council manages Home Energy Saving Schemes for private homes, offering free energy efficiency advice, a condensing boiler scheme and grants for insulation measures for qualifying households. The project idea of "Fifty-Fifty", which was born in the first half of the 1990s, is that energy and water savings will partly be paid back to schools. The first round was carried out in 1994/95. The initial success led to an extension of the program to more and more schools in Hamburg. Since 2000/01 almost all schools in the area took part in the programme. Fifty percent of the energy savings realised by changing behavior was returned to the schools and the other 50% was used to consolidate the municipal household. The result is that everyone wins; the school improves its implementation possibilities, the authorities have less energy costs and society benefits due to the reduction in the environmental impact. The program ended in 2007, since no further energy savings could be realised and the potential of savings had been exhausted. [5].

However, the analysis of the possible potential role of this financial mechanism for the implementation of energy efficiency investments is nonexistent in the literature. Considering the above, the scope of the current paper is to investigate the potential of implementing JESSICA as a complementary financing mechanism in the context of energy efficiency development in Greek buildings. In addition, the successful financing of the strategic plan for improving energy efficiency by Rhodes Municipality are analyzed in this paper. It is noted that the Municipal Council of Rhodes has submitted an application for financing by the "EXOIKONOMO" Government Initiative, aiming at further support of the implementation of its sustainable energy strategy.

The structure of the paper is presented as follows:

- The section that directly follows presents the methodological notes of the current paper.
- The third section presents the progress of the financing energy efficiency investments in Greece, based on recent information.
- The analytical description of the energy efficiency investments plan is presented in the fourth section.
- An integrated financial analysis is performed in the fifth section, in order to illustrate whether, under the specific circumstances, the energy efficiency interventions are feasible in financial terms.
- The paper closes with the concluding remarks regarding the overall evaluation of the applicability of JESSICA in the Greek sustainable urban areas.

2. The methodology

A rigid methodology was followed, which incorporated four (4) steps:

Step I – Desk analysis of financial initiatives in energy efficiency sector: The first step reviewed an in-depth analysis of the financial schemes for energy efficiency investments based on all the available sources and implemented activities. In specific, Streimikiene et al. [4] analyzed the use of EU structural funds for sustainable energy development in EU member states, while Dunkerley [7] presented the context and overview of financing in the energy sector. In addition, Sloan et al. [8] examined the financing schemes and funds of the sustainable energy market as well as Zoppellari [9] studied the financial sources and investment evaluations as regards the financing energy-saving projects and Mills et al. [10] analyzed the financial and performance risk in energy savings projects. In addition, Sundberg et al. presented the financing scheme between an industrial plant and a municipal utility co in Sweden [11], while Painuly et al. [12] examined the mechanisms and barriers regarding promoting energy efficiency financing and ESCOs in developing countries. Yang [13] studied an investment in the industrial energy efficiency sector and Umstattd [14] examined the incentives and barriers of future energy efficiency improvements. Moreover, Dellink et al. [15] analyzed the burden of financing adaptation to climate change, Northrop et al. [16] studied the financing household solar energy in the developing world, while Pacca focused on the financing aspects of electricity

saving's in Brasil [17]. Liming [18] developed a comparison between China and India about financing rural energy and Mourelatos et al. [19] examined the economics of energy-conservation measures in Greece. In addition, Ramachandra [20] described a regional integrated energy plan, while Derrick [21] analyzed the financing mechanisms for renewable energy, as well as Nihous and Syed [22] proposed a financing strategy for small OTEC plants. Last, Chrysostomidis et al. [23] assessed issues of financing a CO_2 transportation pipeline infrastructure, while Patlitzianas and co-workers [24] present an analysis for supporting the Sustainable electricity technologies in Greece.

Step II – Analysis of energy efficiency financial sector in Greece: The second step included information collection for the energy efficiency sector and its financial opportunities in Greece (January–December 2009). In particular, the collected information are based on the contribution by: Ministry of Environment, Energy and Climate Policy (http://www.minenv.gr/); Centre for Renewable Energy Sources (CRES) (www.cres.gr), Regulation Energy Authority (RAE) (www.rae.gr) as well as Greek Commercial Banks.

Step III – Energy audits in Rhodes Municipality: Detailed energy audits were implemented in four buildings in the Rhodes Municipalities (2009). In specific, the following procedure was followed:

- Collection of data (energy bills in each building, identification of the buildings' equipment, e.g., lighting, water and space heating, air conditioning, elevators and electric devices such as computers, refrigerators and kitchens, etc.).
- Measurements (energy consumption, temperature, thermal losses, etc.).
- Analysis of the data–energy balances.
- Choice of the appropriate energy saving actions. The detection of the energy improvement actions was located through the estimated energy indicators.
- Reporting.

Step IV – Assessment of the plan's financing through the JESSICA mechanism: The last step was analyzed the assessment of the "JESSICA" mechanism supporting to the energy efficiency investments in a typical Greek municipality (December 2009–June 2010). In specific, the purpose of financial assessment was to investigate the ability of Rhodes Municipality to repay the loan provided by an Urban Development Fund (UDF[1]), which will be established for the purpose of financing the implementation of energy efficiency plans of Municipal Authorities. All aspects of the energy efficiency investments plan was analyzed by developing four alternative scenarios.

3. Green energy financing by banking institutions: the progress so far

"Green energy technologies" are gradually becoming a serious case for banking institutions in Greece. The recent legislative initiatives regarding the energy efficiency in buildings (L.3661/2008, Regulation of Energy Efficiency in Buildings 9/4/2010), the utilization of Renewable Energy Sources (L.3468/2006, L.3851/2010) and the National Program of Photovoltaic Systems on houses' roofs (4/6/2009), have become the basic drivers for some banking institutions to develop specialized products to finance relevant projects.

Based on a market research on banking institutions in Greece, two main "green energy product categories" are summarized:

- Loans provided to households for the implementation of small scale PV systems on house roofs: These products are basically driven by the National Program for the PV systems installation on roofs (PV systems with no more than 10 kWp power), which under certain conditions ensure a stable revenue stream, thereby facilitating the payments of debt service.
- Loans provided to enterprises for the development of photovoltaic stations of bigger capacity.
  (>10 kWp): The basic drivers for launching these products are:
  - They are eligible for grants in the context of National Development Law 3299/04. Most of the banks do not finance these investments if they have not been approved by the Ministry of Economy, Competitiveness and Shipping.
  - In most cases, banks finance up to the 75% of the total PV investment cost. The rest 25% should be provided by the investor himself.
  - PV systems of capacity less than 1 MW are excluded from the special issuance of Permission of Production provided by the Regulatory Authority for Energy (RAE). As a result, in this case it is much easier to install a PV station compared to PV stations with power more than 1 MW.
  - The upcoming National Development Law will not include state grants for Photovoltaic Fields.
  - The feed-in tariffs in Greece for electricity produced by PV systems are still considered as competitive enough. For example, the tariff for PV systems up to 10 kWp installed on roofs, is 0.55 €/kWh. The feed-in tariff for PV stations smaller than 100 kWp is 0.45 €/kWh and finally for projects larger than 100 kWp the tariff is 0.40 €/kWh.[2]

Table 1 presents the existing financial products addressing energy efficiency projects in the Greek market.Based on the collected information of Greek Commercial Banks for "green energy technologies", the following comments are summarized:

- In order to leverage private resources from banking institutions, structural funds should invest in UDFs a critical mass of resources. It was avoided to refer to a specific amount; however it seems that a threshold for banks is approximately €50 million per UDF.
- Banks are very cautious regarding as energy generation investments through RES because of the delays incurred in issuing the appropriate licenses.
- The minimum budget per project as far as purchasing power parity (PPP) is concerned should be no less than €30 million in order to be considered by banking institutions.

4. A sustainable energy investments plan in Rhodes Municipality

4.1. The plan's content

4.1.1. General

The integrated energy efficiency investments plan of Rhodes' Municipality consists of four basic categories of interventions provided by the "EXOIKONOMO" initiative. These interventions briefly are the appliance of energy efficiency measures in municipal buildings and in communal facilities, appliance of transportation measures and finally the sensitization and improvement of awareness.

[1] Urban Development Fund is analyzed in Chapter 5.

[2] Until August 2010. The feed in tariff for PV stations in fields gradually reduces every 6 months.

Table 1
Energy financial products in Greece.

Banking institution	Name of product	Term of the loan	Interest rate	Eligible investments	Amount
Alpha Bank	Photovoltaic loans	10	3 months Euribor + 375% + 0.6%	PV systems of up to 150 kW	15–60% of initial investment, basic criterion to be granted by Development Law 3299/04
National Bank of Greece	Green loan	Up to 7	ECB + 6%	Energy efficiency measures in households, PV on roofs, purchase of hybrid vehicles	Up to €30,000
National Bank of Greece	Energy production through photovoltaic systems	Up to 10	5.75–6.85%	PV systems of up to 150 kW	15–60% of initial investment, basic criterion to be granted by Development Law 3299/04
Pireaus Bank	Green loans	Up to 10	7.30%	Energy efficiency measures in households, PV on roofs	Up to €50,000
Pireaus Bank	Photovoltaic solutions	Flexible	Euribor/libor + spread	Photovoltaic systems	Flexible
Commercial Bank	Home ecological	Up to 10	3 months euribor + 6.5 + 0.6%	Energy efficiency measures in households, PV on roofs	Up to €30,000
EFG Eurobank	Ecological-photovoltaics	Flexible	Varies	Photovoltaic systems	Up to 100% of PV cost
Agricultural Bank of Greece	Photovoltaic systems financing	Up to 15	Varies	Photovoltaic systems	15–60% of initial investment, basic criterion to be granted by Development Law 3299/04

4.1.2. Energy efficiency measures in municipal buildings

4.1.2.1. Results of the energy audits. There are four buildings which will be renovated in the context of the energy efficiency investments plan undertaken by Rhodes' Municipality:

- *Town hall*: The town hall, which is a classical building and has been built during the Italian occupation period (1938–1939). Due to its traditional characteristics, every kind of intervention is under the authority of the Municipal Department of Medieval City Protection. Due to its historical character every kind of intervention should be undertaken very cautiously so that no to disturb its traditional heritage. The replacement of old windows, doors and shutter assemblies is quite urgent, but the new equipment has to be in accordance with the historical character of the specific building.

  It is noted that a small number of windows have been recently replaced aiming to energy efficiency and improvement of the standards of living of the building's users. As far as lighting is concerned, old-tubular fluorescent lamps are used in the building.

  The central heating system has been out of operation during the last five years. The local air conditioning units are used for covering both, the thermal and cooling needs. The use of the local units is wasteful and environmentally unfriendly.
- *Municipal theatre*: The municipal theatre is also a classical building which was built in 1938–1939. It is located in Eleftheria's Square, near the city hall of Rhodes Municipality. It is also under the authority of Department of Medieval City Protection and due to its historical character every kind of intervention should be undertaken very cautiously. The building suffers from inefficient frames and insulation, but the new equipment has to be in accordance with the historical character of the building. The heating system has been out of operation during the last 5 years. The local air conditioning units are used for the covering both, the thermal and cooling needs.
- *Primary school*: The 15th primary school of Rhodes was built in 1984. The building suffers from inefficient frames and shutter assemblies, while there is an urgent need for improving the existing lighting system. One of the reasons this school was chosen for implementing energy efficiency measures was that the local school community is very sensitive is such issues. It has to be noted that a number of awareness and sensitization activities have been implemented by the local community of the school.
- *High school*: The complex of 1st high school of Rhodes was built in 1975 and consists of six separate buildings utilized for classes, offices and laboratories. The buildings suffer from significant thermal energy losses due to inefficient frames.

4.1.2.2. The proposed actions. The following eligible actions are summarized:

- Thermal insulation.
- Replacement of frames, doors and shutter assemblies.
- Improvement of the lighting system.
- Installation of energy monitoring and assessment systems.

The allocation of actions in each building is presented in Table 2.

For the necessary calculations made for Table 2, the material cost of thermal insulation interventions was considered at 12.5 €/m^2 and the working costs at 17.5 €/m^2. Additionally, for the benefits calculation a series of assumptions were made. Specifically, the insulation intervention is considered as resulting in a 20% saving of thermal energy needs, the replacement of old windows in 13% energy saving, and the lightning system improvement in 34% electricity saving.

Furthermore, the calculation of annual Primary energy ($Q_{Primary}$) is done using the following expression:

$$Q_{Primary} = Q + \frac{Q_{el}}{n_{el}}$$

Table 2
Buildings' energy efficiency interventions.

Building	Interventions	Investment cost (€)	Annual energy saving benefits (kWh)	Annual financial gains (€)
Town hall	• Insulation • Replacement of old windows, doors and shutter assemblies • Improvement of the Lighting System • Energy monitoring and assessment systems	36,034,399	367,151	72,035
Municipal theatre	• Insulation • Replacement of old windows, doors and shutter assemblies • Energy monitoring and assessment systems	6,795,995	5447	106,870
15th primary school	• Replacement of old windows, doors and shutter assemblies • Improvement of the Lighting System • Energy monitoring and assessment systems	8,041,104	15,782	309,642
1st high school	• Replacement of old windows, doors and shutter assemblies	1,365,850	2,768,826	543,244
Total		645,300	8,563,236	1,680,106

whereas Q_{Primary}: annual energy consumption measured in kWh; Q: annual energy consumption – except for electricity – for heating and cooling needs measured in kWh; Q_{el}: annual electricity consumption for building's heating and cooling measured in kWh; n_{el}: efficiency factor of the electricity plant. The factor is considered at 0.37 for on grid plants, and 0.29 for off grid plants.

The price of kWh is estimated at the upper limit (€0.18+ VAT 9%/kWh) within the price range charged by Public Power Corporation (PPC SA), since it is assumed that this benefit will come from the excess energy consumed, which is charged at the highest rate.

4.1.3. Energy efficiency measures in the communal facilities

This kind of action includes the implementation of various bioclimatic measures in Kountourioti Square in the Central of Rhodes Municipality, whose total area is 6555 m^2. These measures include the installation of special tiles of high reflectivity, wooden posts and roof tiles, plantations and other bioclimatic material. The total budget for the implementation of the above measures is €154,700. Due to the investment character, the energy savings for this kind of action is not easy to be estimated.

4.1.4. Energy efficiency in transportation

As far as the transportation sector is concerned, the municipal authority has included in its action plan an urban mobility survey which will focus on accessibility to particular places of the city, aiming to reduce the usage of private vehicles and fuels' savings. The total budget of the survey will be €50,000. The total benefit for Rhodes' Municipality, in terms of energy savings cannot be determined, however, it was estimated that the implementation of the study will reduce petrol consumed by private vehicles by 895,000 L annually.

4.1.5. Energy efficiency dissemination, awareness and communication actions

Rhodes' Municipality will bring into effect a dynamic and multidimensional communication plan including dissemination, networking and publicity actions regarding energy efficiency which will address Municipality's employees and citizens of Rhodes. The main objective of the dissemination plan is to influence the behavior of municipal employees and citizens towards more rational use of energy, so that to achieve energy savings.

The dissemination actions are implemented in three phases:

- *First phase:* A generic awareness program will be developed, addressing total population by using various communication means such as direct mails, e-mails, meetings, conferences, etc.
- *Second phase:* The second phase aims to more specific target groups through the use of Internet, publishing and distribution of brochures-newsletters – specified magazines, organization and implementation of workshops and conferences.
- *Third phase:* The last phase aims to the dissemination of the program's output giving emphasis on publicity activities and increasing awareness regarding best practices. Some of the means that will be used are the Internet, the utilization of the regional media, etc.

Although there is no technical/bibliographic date that could justify the energy savings achieved through more rational behavior, it is reasonable to assume that the impact of the improvement of awareness and sensitization of Municipal employees could reach 5% reduction of total energy consumption. The total energy cost of the Rhodes Municipality was approximately 500,000€/year in 2008, based on the PPCs official consumption data, coming from the Municipal Financial Department, as well as estimations made by the technicians of Rhodes Municipality. This figure included the energy consumption of buildings, public lighting, as well as the rest municipal facilities.

Therefore, based on the results of the dissemination plan, the energy savings of the municipal buildings and the facilities could reach 5% of the total energy consumption or $0.05 \times 500{,}000$€/year = 25,000€.

5. Successful financing of the plan through JESSICA mechanism

5.1. The relationship between "investments' plan" and "sustainable urban development"

The integrated energy investments plan of Rhodes Municipality consists of four different categories of interventions (buildings, communal spaces, transport and awareness). Some of them have a direct impact on energy conservation and some of them may have an indirect impact which, either cannot be measured, or its measurement is based on assumptions regarding behaviors of people, as is the case for awareness/sensitization activities.

In addition, the interventions included in the investments plan of Rhodes' Municipality have some peculiarities regarding the individual characteristics of the buildings renovated (such as the traditional character of the town hall and the city theatre), which raise the costs of renovation, while at the same time restrict the range of interventions to be undertaken.

Another issue to be mentioned is the integrated character of the investments plan, since it combines various interventions

implemented into various types of venues, aiming to improve the quality of life in the city. The benefits arisen from the implementation of this investments plan could be categorized as following:

- *Environmental:* It is estimated that the implementation of these interventions will result in the reduction of CO_2 emissions by 388.58 t annually (from the decrease of electricity produced and fossil fuels use). It should be noted that this is the direct impact on CO_2 emissions, not taking into consideration the indirect effect of other interventions undertaken. Improvements in communal spaces (bioclimatic interventions) improve the microenvironment while they also improve the quality of life of the city's inhabitants.

At this point, it should be noted that the calculation of CO_2 emissions is done with the use of the following equation:

$$m_{CO_2} = Q \times \frac{F_{fuel}}{Hu_{fuel}} + Q_{el} \times F_{station}$$

whereas m_{CO_2} is produced mass of gaseous pollutant, Q: annual energy consumption – except for electricity – for heating and cooling, Q_{el}: annual consumption of electric energy for building's heating and cooling (kWh), F_{fuel}: fuel's gaseous emissions factor (kg of pollutant/kg fuel). This factor is considered at:

- 3142 kg emission/kg of fuel diesel,
- 3030 kg emission/kg of fuel gas,
- 2715 kg emission/kg of natural gas.

$F_{station}$: station's gaseous pollutant emission factor (g pollutant/kWh). This factor is considered at:

- 0.85 kg of CO_2/kWh for Stations connected to the Grid,
- 10,625 kg of CO_2/kWh for off Grid Stations connected to the grid.

Hu: net calorific value (kWh/kg). This factor is considered at:

- 11.92 kWh/kg of fuel diesel,
- 12.73 kWh/kg of fuel gas,
- 13.83 kWh/kg of natural gas.

- *Economic:* The directly measurable financial benefits for Municipality of Rhodes account to approximately €16,000 annually, while the indirect effect may reach €25,000 annually. In addition, it is estimated that through the implementation of urban mobility measures there will be a decrease of petrol consumption of approximately 895,000 L annually (approximately €940,000 savings in today's petrol retail prices). Finally, the cost of interventions undertaken create a demand for projects of total value €1,000,000 (including VAT), thereby leveraging local economy.
- *Social:* There will be an increase of awareness on energy conservation issues, and increased sensitization of civilians regarding the necessity of personal involvement on environmental issues.

Taking into consideration the above, Rhodes' Municipality energy efficiency investments plan is eligible for financing in the context of JESSICA, since it fulfills the basic criteria for sustainable urban development, by combining different categories of interventions which overall improve the quality of life in the city in an integrated way.

5.2. Financial analysis of the current plan

Financial analysis investigates whether energy savings arisen from the implementation of energy efficiency measures are adequate to repay the loan. However, since the energy efficiency investments plan of Rhodes' Municipality consists of interventions that conclude to particular savings (compensating interventions) and interventions that do not conclude to specific savings (not compensating investments), it is critical to investigate all aspects of the energy efficiency investments plan by developing alternative scenarios as follows:

- *Scenario 1*: Investigation of the adequacy of direct and indirect energy savings to repay a loan based on total investment cost, not taking into consideration the grants provided by initiative "EXOIKONOMO" (100% financed by the UDF).
- *Scenario 2*: Investigation of the adequacy of direct and indirect energy savings to repay a loan which will cover the own contribution of the Municipal Authority on total investment cost (30% financed by the UDF).
- *Scenario 3*: Investigation of the adequacy of direct energy savings to repay a loan based only on the investment cost related to compensating interventions (100% financed by the UDF).
- *Scenario 4*: Investigation of the adequacy of direct energy savings to repay a loan based only on the investment cost related to compensating interventions taking into consideration only own participation of Municipality (30% financed by the UDF).

Therefore, the alternative scenarios are based on the following variables:

- *Grant:* It was investigated to the extent to which Rhodes' Municipality will be able to repay a loan, through energy savings, if its investments plan will not be financed by the initiative "EXOIKONOMO".
- *Risk of the investments plan:* It is considered the degree of certainty of the cash flows (savings) generated by the investments plan. Therefore, two kinds of savings are distinguished:
  - *Direct energy saving:* These savings that are directly attributable to specific interventions and according to measurements performed, we can be pretty sure that the energy savings will be achieved.
  - *Indirect energy saving:* These savings that can be generated through rationalization of behaviors or other savings that cannot be measured in the planning phase. These kinds of savings include a great degree of risk since they are based on assumptions regarding the impact of the relative interventions on energy conservation.
    - *Investment cost:* The chosen investments have a direct impact on energy savings from these investments that have an indirect, or no impact on energy savings. Evaluation is performed on these investments that have a direct gain. Investments that do not generate validated gains are not included in the evaluation.

The above scenarios are analyzed based on the assumptions that the time period of the loan will be 15 years and the interest rate will be fixed at 3%. The total budget of the investments plan is €1,000,000 and is allocated as follows (Table 3):

Therefore, the investment cost related to compensating interventions is €645,300. The total grant that will be provided to Rhodes' Municipal Authority, will be €700,000 and the remainder amount should be covered by Municipality's own contribution.

Scenario 1 (no grant, direct and indirect financial gains): Taking into consideration the basic assumptions related to loan terms (time and interest rate) and considering also that the investments plan will be completed in a time framework of approximately 3 years, while the major compensating interventions will be completed in two years, the basic results of financial calculations are:

Table 3
Budget of energy efficiency investments plan.

Intervention	Budget	Compensating
Renovation of town hall	36,034,399	√√
Renovation of municipal theatre	6,795,995	√√
Renovation of 15th primary school	8,041,104	√√
Renovation of 1st high school	1,365,850	√√
Bioclimatic applications in communal spaces	154,700	√
Urban mobility study	50,000	√
Dissemination	50,000	√
Technical assistance	100,000	
Total	1,000,000	

Note: (√√): Directly attributed savings, (√): indirect or not measurable benefits.

- Total financial gains are not adequate enough to repay the loan payments since the debt service coverage ratio is 50%. For achieving a DSCR (debt-service coverage ratio) of 100%, the debt should have a period of 24 years with 0% interest rate.
- In strictly financial terms, this investment is not profitable since NPV is negative (discount rate 3%) and IRR on equity iterate due to negative cash flows.

Scenario 2 (70% grants, direct and indirect financial gains): In this scenario, investment return is based on Municipality's own contribution, considering that 70% of the investment will be subsidized by the initiative. Therefore, financial ratios are calculated on investment cost €300,000. The basic results of this calculation are:

- Total financial gains are plenty enough to pay the annual payments of the loan. Debt service coverage ratio is 166%.
- Net present value is positive and IRR on equity is 8%. That means that in terms of Municipality's own contribution (Return on Equity), this is a profitable investment.

Scenario 3 (no grant, compensating investments, direct financial gains): In this scenario, investment return is based on the investment cost of compensating interventions and financial gains include only those gains that are directly attributable to these specific interventions. In this case, essentially, it is assumed that Municipality will not benefit from "EXOIKONOMO" grants and it will finance these compensating investments with a loan. The results of these calculations are the following:

- Financial gains are not adequate enough to pay back loan payments. Debt coverage service ratio is only 31%. For achieving a DSCR of 100%, the debt should have a period of 38 years with 0% interest rate.
- Net present value is negative and IRR on equity iterate due to negative cash flows.

Scenario 4 (70% grant, compensating investments, direct financial gains): In this scenario investment return is based on Municipality's own contribution on the investment cost that is directly related to compensating investments, since 70% of this investment will be financed by "EXOIKONOMO". Financial gains are directly attributable to these investments. In this case, essentially, it is assumed that Municipality will benefit from EXOIKONOMO grants, only for those investments that produce specific savings, while its own contribution will count for 30% of the above amount. The results of these calculations are the following:

- Financial gains marginally cover the debt payments since DSCR is 104%
- In terms of return, IRR on equity is marginally 0% and NPV is marginally negative.

Table 4
The results of scenarios.

Scenario	Net present value (€)	DSCR (%)
Scenario 1	−67,692,333	50
Scenario 2	18,996,937	166
Scenario 3	−42,048,114	31
Scenario 4	−3,998,029	104

Table 4 illustrates the results of scenarios.

6. Discussion and conclusion

The utilization of JESSICA for financing energy efficiency investments plans of Municipal Authorities (as a complementary means in the context of "EXOIKONOMO initiative") seems to fit well into the overall philosophy of "JESSICA" as a financing mechanism of integrated urban development. Indeed, complementary projects that contribute to the improvement of quality of life, combining also the environmental, economic and social aspect of sustainability seem to be the critical factors that validate the eligibility of such interventions within the "JESSICA" framework.

Financial analysis of the current case study illustrates that grants provided in the context of "EXOIKONOMO" are critical for financing energy efficiency interventions of Rhodes' Municipality. Cash flow forecasts show that energy savings are not sufficient to pay back the overall investment while ROI is negative.

However, when the investment is appraised in the context of Municipality's own contribution, then cash flow is sufficient to repay debt and return on investment is positive. There is, however, great risk involved because cash flows include savings that are questionable.

The same conclusions arise when only the compensating projects are incorporated into the financial model. A 100% financing by UDF does not seem to be feasible since cash flows are not sufficient to pay back debt and ROI is negative. Taking into consideration that the projects are 70% financed by grants and 30% by UDF, the IRR is zero, while cash savings are marginally sufficient to pay back the debt. In this case, however, the projected savings are safer, since they are based on more precise measurements.

To sum up, the peculiarities of the particular interventions undertaken by Rhodes Municipality should be taken into consideration when appraising financial performance. Statements like, "*the investments plans that will be submitted in the context of EXOIKONOMO illustrate low ROI*" constitute oversimplification and should be avoided, since each action plan will have its own characteristics regarding the compensating character of the interventions undertaken. It is very reasonable to assume that Municipal Authorities may include in their investments plans that are less compensating than others. The issues to be investigated is the total savings projected, the degree of risk inherent in these savings and the overall financial capability of Municipal Authorities to pay back their obligations to UDF if results are not as expected.

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Further reading

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